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(71)Applicant : TOKYO ELECTRIC POWER CO INC:THE

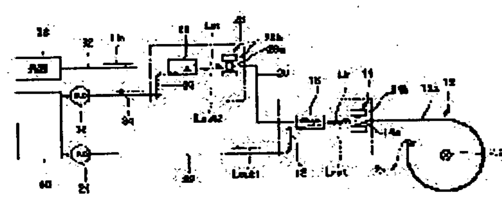
(72)Inventor : KUROSAWA KIYOSHI
YOSHIDA SATORU

(54) CURRENT MEASURING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a simple-structured current measuring device which increases incident light quantity of a light receiving element.

SOLUTION: The measuring device has an optical fiber sensor 12 which is placed around the outer periphery of a conductor 10 through which measured current I0 flows, and essentially measures Faraday rotation angle of linear polarized light which is rotated with magnetic field of the measured current I0 when linear polarized light which is entered from one end of the sensor 12 is reflected on another end. A first ferromagnetic Faraday element 14 and first calcite 16 are provided on one end of a fiber 12a. The element 14 rotates polarized plane of linear polarized light by 22.5°, is light transmittant type, and has a YIG block 14a and a permanent magnet 14b. A prism 18 and one end opening of a polarized plane holding fiber 20 are placed on the incident end side of the first calcite 16. The other end opening of the fiber 20 is placed on an optical axis of a second ferromagnetic Faraday element 26. The Faraday element 26 rotates the polarized plane of linear polarized light by 45°. A second calcite 28 is placed on the incident end side of the element 26.



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CLAIMS

[Claim(s)]
[Claim 1] Circumference installation of the optical fiber sensor is carried out at the periphery of the conductor with which the measured current is flowing. In the measuring device of the current which measures the faraday's rotation angle of said linearly polarized wave light which rotates the linearly polarized wave light which carried out incidence from the end side of said optical fiber sensor by the field of said measured current when it is made to reflect by the other end side of said optical fiber sensor A ferromagnetic Faraday cell with the magnetic-saturation nature of the light transmission mold which is installed in either the incidence edge of said optical fiber sensor, or a reflective edge, and only a predetermined include angle makes rotate the plane of polarization of said linearly polarized wave light, The measuring method of the current characterized for having the polarization separation component of the light transmission mold which is installed in the incidence edge [of said optical fiber sensor], or front end side of said ferromagnetic Faraday cell, separates spectrally the outgoing radiation light from said optical fiber sensor, and is led to a photo detector by things.
[Claim 2] Said ferromagnetic Faraday cell is the measuring device of the current according to claim 1 characterized by impressing optical bias to said linearly polarized wave light.
[Claim 3] The measuring device of the current according to claim 1 characterized by impressing the field which carries out magnetic saturation to said ferromagnetic Faraday cell.
[Claim 4] The measuring device of the current according to claim 1 characterized by setting said predetermined include angle of said ferromagnetic Faraday cell as 22.5 degrees.
[Claim 5] The measuring device of the current according to claim 1 characterized by using a lead glass optical fiber for said optical fiber sensor.
[Claim 6] The measuring device of the current according to claim 2 characterized by using a permanent magnet for impression of the field of said ferromagnetic Faraday cell.
[Claim 7] The measuring method of the current according to claim 1 which said measured current is an alternating current, carries out photo electric conversion of the two light which carried out polarization separation with said polarization separation component, and considers the sum of the modulating signal of two acquired electrical signals as an output.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] About the measuring device of the current using the Faraday effect, especially, in the measuring device of a current using an optical fiber sensor, this invention carries out incidence of the light from the end side of a sensor, and relates to the amelioration technique of the amperometry equipment of the reflective mold reflected by the other end side.
[0002]
[Description of the Prior Art] The measuring device of the current using the Faraday effect which the plane of polarization of light rotates according to an operation of a field is known, and there is an advantage of not being influenced of electromagnetic noise in the measuring device of such a current, for example, it is used for measurement of the current within the switchgear of a gas insulation type.
[0003] There is a thing of a method which makes the periphery of the conductor with which the measured current is flowing go an optical fiber sensor around among the measuring devices of this kind of current, and that example is indicated by JP,7-248338,A and the technical paper IEEE of the 1997 issue (PE-494-PWRD-0-01-1977).
[0004] With the measuring device of the current currently indicated by this official report and technical paper, by reflecting the linearly polarized wave light which carried out incidence from the incidence edge of the optical fiber sensor arranged so that the conductor with which the measured current is flowing may be surrounded by the end face of the opposite side, linearly polarized wave light is made to go within an optical fiber sensor, and it has composition which carries out outgoing radiation from an incidence edge again.
[0005] The following features are acquired in the measuring device of a current using the optical fiber sensor of such a reflective mold.
** . When there is no birefringence in the stability optical fiber sensor of the polarization to deformation of a curve, the polarization condition of the light which carries out re-outgoing radiation from the incidence edge of an optical fiber sensor stops being dependent on curvilinear deformation of an optical fiber sensor.
** . -- stability torsion of the polarization to change of torsion stress double refraction -- add a circle birefringence to an optical FAIBA sensor, and even if temperature dependence is in the magnitude of a circle birefringence, stop in addition, depending on temperature for the polarization condition of the light which carries out re-outgoing radiation from the incidence edge of an optical fiber sensor in the configuration aiming at the stability of polarization
** . By making the expansion light of a faraday's rotation angle go, a faraday's rotation angle can change twice and a modulation factor can be raised.
[0006] Since it has such features, the stable property can be given to various disturbance to an optical fiber sensor, and sensibility can be raised by improvement in a modulation factor.
[0007] The disturbance of a place here is addition of the force made to transform the curve of an optical fiber sensor, and addition of the force which makes an optical fiber sensor ingredient generate stress and

distortion.
[0008] However, according to examination of this invention persons, there was a technical technical problem explained below in the measuring device of a current using the reflective mold optical fiber sensor currently indicated by the above-mentioned official report etc.
[0009]
[Problem(s) to be Solved by the Invention] That is, in the measuring device of a current using the reflective mold optical fiber sensor currently indicated by the official report mentioned above, the beam splitter constituted with the semitransparent mirror just before the incidence edge of an optical fiber sensor is installed as a reader of a faraday's rotation angle generated in the optical fiber sensor.
[0010] However, even if a beam splitter separates spectrally and designs light the optimal using transparency and reflection of light as known well, the quantity of light which can carry out incidence to a photo detector turns into 25% or less which passed the polarizer of the quantity of light on a principle.
[0011] If the amount of incident light of a photo detector decreases, problems, like the processing high-class to the electronic circuitry for light-receiving to which a burden is placed on the light source which the SN ratio of current detection gets worse and cannot make a speed of response quick, and a life of a lamp becomes short is needed will be caused.
[0012] Moreover, a manufacture process becomes very complicated in order to form the reflective film and an antireflection film in a beam splitter, while the optimum design (optimization of a reflection factor and permeability, optimization of the reflection and the permeability ratio of P polarization and S polarization, control of a jump of the phase of the reflex time of P polarization and S polarization) of the polarization property of a beam splitter becomes complicated.
[0013] Furthermore, since the beam splitter needed to set the optical axis by other optics correctly, it had the problem of needing precise structure for the anchoring part. By the approach proposed by the technical paper especially mentioned above, in order to repeat unstable transparency and reflection with a beam splitter or a half mirror no less than 4 times, such a problem becomes very remarkable.
[0014] This invention is to offer the measuring device of a current with which a configuration becomes easy while it is made in view of such a conventional trouble and can make the amount of incident light of a photo detector increase.
[0015]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention carries out circumference installation of the optical fiber sensor at the periphery of the conductor with which the measured current is flowing. In the measuring device of the current which measures the faraday's rotation angle of said linearly polarized wave light which rotates the linearly polarized wave light which carried out incidence from the end side of said optical fiber sensor by the field of said measured current when it is made to reflect by the other end side of said optical fiber sensor A ferromagnetic Faraday cell with the magnetic-saturation nature of the light transmission mold which is installed in either the incidence edge of said optical fiber sensor, or a reflective edge, and only a predetermined include angle makes rotate the plane of polarization of said linearly polarized wave light, It was installed in the incidence edge [of said optical fiber sensor], or front end side of said ferromagnetic Faraday cell, and has the polarization separation component of the light transmission mold which separates spectrally the outgoing radiation light from said optical fiber sensor, and is led to a photo detector. Since according to this configuration a faraday's rotation angle is read without using reflection of light, the quantity of light sent out to a photo detector side can be made to increase. Said ferromagnetic Faraday cell can impress optical bias to said linearly polarized wave light. The field which carries out magnetic saturation to said ferromagnetic Faraday cell can be impressed. Said predetermined include angle of said ferromagnetic Faraday cell can be set as 22.5 degrees. A lead glass optical fiber can be used for said optical fiber sensor. A permanent magnet can be used for impression of the field of said ferromagnetic Faraday cell. Said measured current is an alternating current, photo electric conversion of the two light which carried out polarization separation with said polarization separation component can be carried out, and the sum of the modulating signal of two acquired electrical signals can be considered as an output.
[0016]

[Embodiment of the Invention] Hereafter, the gestalt of desirable operation of this invention is explained to a detail with reference to an accompanying drawing. Drawing 1 shows the 1st example of the measuring device of the current concerning this invention.
[0017] The measuring device of the current shown in this drawing has the optical FAIBA sensor 12 by which circumference installation was carried out on the periphery of the conductor 10 with which the measured current I0 is flowing. It is amperometry equipment of the reflective mold which makes it radical Motohara ** to measure the faraday's rotation angle of the linearly polarized wave light which rotates the linearly polarized wave light which carried out incidence from the end side of this optical fiber sensor 12 by the field of the measured current I0 when it is made to reflect by the other end side of the optical fiber sensor 12.
[0018] The optical fiber sensor 12 consists of optical FAIBA 12a which consisted of lead glass FAIBA, and reflective mirror 12b prepared in the other end side (reflective edge) of this optical FAIBA 12a.
[0019] While 1st ferromagnetism Faraday cell 14 is formed on the optical axis by the side of an end optical fiber 12a side (incidence edge), the 1st calcite (1 shaft birefringence optic) 16 is formed in incidence one end of this 1st ferromagnetism Faraday cell 14.
[0020] 1st ferromagnetism Faraday cell 14 is a thing of a light transmission mold which carries out predetermined include-angle (22.5 degrees) rotation of the plane of polarization of linearly polarized wave light, and consists of YIG block 14a and permanent magnet 14b installed in the periphery of this block 14a.
[0021] Magnetic saturation of the field of permanent magnet 14b is carried out, it has come and the field which carried out magnetic saturation is impressed to YIG block 14a.
[0022] While the 1st calcite 16 makes the linearly polarized wave light which carried out incidence on the optical axis penetrate as it is, the birefringence of the incident light which shifted from the optical axis is carried out, it carries out outgoing radiation, and prism 18 and end opening of plane-of-polarization maintenance FAIBA 20 are arranged at incidence one end of a calcite 16.
[0023] Contiguity arrangement of the end opening of a multimode optical fiber 22 is carried out at outgoing radiation one end of prism 18, other end opening of this multimode optical fiber 22 is arranged near the optoelectric transducer 24, and the outgoing radiation light from prism 18 carries out incidence to an optoelectric transducer 24.
[0024] Other end opening of the plane-of-polarization maintenance fiber 20 is arranged on the optical axis of 2nd ferromagnetism Faraday cell 26.
[0025] Like 1st ferromagnetism Faraday cell 14, 2nd ferromagnetism Faraday cell 26 is a thing of a light transmission mold which carries out predetermined include-angle (45 degrees) rotation of the plane of polarization of linearly polarized wave light, and consists of YIG block 26a and permanent magnet 26b installed in the periphery of this block 26a.
[0026] The 2nd calcite 28 is installed in incidence one end of 2nd ferromagnetism Faraday cell 26. This 2nd calcite 28 is equipped with the same optical function as the 1st calcite 16.
[0027] Prism 30 and end opening of plane-of-polarization maintenance FAIBA 32 are arranged at incidence one end of the 2nd calcite 28.
[0028] Contiguity arrangement of the end opening of a multimode optical fiber 34 is carried out at outgoing radiation one end of prism 30, other end opening of this multimode optical fiber 34 is arranged near the optoelectric transducer 36, and the outgoing radiation light from prism 30 carries out incidence to an optoelectric transducer 36.
[0029] Other end opening of the plane-of-polarization maintenance fiber 32 is connected to the light source 38. The polarization light of the linearly polarized light carries out incidence of the light by which outgoing radiation is carried out from the light source 38 to a fiber 32 by making the polarizer of an illustration abbreviation etc. penetrate.
[0030] In addition, in response to the fact that the electrical signal sent out from optoelectric transducers 24 and 32, the components shown in drawing 1 with the sign 40 are electronic circuitries which perform data processing which asks for the sum of a modulation factor, for example, are explained by the technical paper (the Institute of Electrical Engineers of Japan paper magazine B, 116 No. 1, pages 93-

103) of issue in full detail in 1996.
[0031] In the measuring device of the current constituted as mentioned above, with the plane-of-polarization maintenance fiber 32, the linearly polarized wave light LIN sent out from the light source 38 is in the condition which maintained the polarization condition, carries out incidence on the optical axis of the 2nd calcite 28, and it penetrates this, without causing a birefringence, and the linearly polarized wave light LIN which carried out outgoing radiation from the 2nd calcite 28 carries out incidence to 2nd ferromagnetism Faraday cell 26.
[0032] The linearly polarized wave light LIN which carried out incidence to 2nd ferromagnetism Faraday cell 26 penetrates this, without 45 degrees being rotated and carrying out incidence to plane-of-polarization maintenance FAIBA 20, and plane of polarization's maintaining this polarization condition, and incidence's being carried out on the optical axis of the 1st calcite 16, and causing a birefringence, in case this is penetrated, and the linearly polarized wave light LIN which carried out outgoing radiation from the 1st calcite 16 carries out incidence to 1st ferromagnetism Faraday cell 14.
[0033] In case the linearly polarized wave light LIN which carried out incidence to 1st ferromagnetism Faraday cell 14 penetrates this, 22.5 more degrees of plane of polarization are rotated, it carries out incidence to the optical fiber sensor 12, and incidence of the reflected light LOUT which reflected the periphery of a conductor 10 by reflective mirror 12b as ** is again carried out to 1st ferromagnetism Faraday cell 14.
[0034] In case the reflected light LOUT passes 1st ferromagnetism Faraday cell 14, 22.5 degrees of plane of polarization are rotated, and it carries out incidence of it to the 1st calcite 16. Consequently, when the reflected light LOUT which carries out incidence to a calcite 16 removes the faraday's rotation angle by the measured current I0, the plane of polarization of the linearly polarized wave light LIN which carried out outgoing radiation from now on will carry out incidence of it, after a total of 45 degrees has rotated.
[0035] For this reason, in case the reflected light LOUT passes the 1st calcite 16, a lifting and reinforcement are made to separate a birefringence spectrally into every 1/2 reflected light LOUT1 and this reflected light LOUT2, and it carries out outgoing radiation.
[0036] The output signal from which incidence of the reflected light LOUT1 was carried out to the optoelectric transducer 24 through prism 18 and a multimode optical fiber 22, and while it was separated spectrally was changed into the electrical signal with the component 24 inputs into an electronic circuitry 40.
[0037] Through the plane-of-polarization maintenance fiber 20, incidence of the reflected light LOUT2 of another side separated spectrally is carried out to 2nd ferromagnetism Faraday cell 26, and where 45-degree plane of polarization is again rotated with a component 26, it carries out incidence to the 2nd calcite 28.
[0038] Consequently, when the reflected light LOUT2 which carries out incidence to the 2nd calcite 28 removes the faraday's rotation angle by the measured current I0, the plane of polarization of the linearly polarized wave light LIN which carried out outgoing radiation from now on will carry out incidence of it, after a total of 90 degrees has rotated.
[0039] For this reason, in case the reflected light LOUT2 passes the 2nd calcite 28, a lifting and its all go a birefringence to a prism 30 side. Incidence of the reflected light LOUT2 which passed prism 30 is carried out to an optoelectric transducer 36 through a multimode optical fiber 34, and the output signal changed into the electrical signal with the component 36 is inputted into an electronic circuitry 40.
[0040] Then, the measured current I0 is searched for by performing signal processing predetermined in the electronic circuitry 40 which received the output signal from optoelectric transducers 24 and 36.
[0041] Now, according to the measuring device of the current constituted as mentioned above, with the combination of ferromagnetic Faraday cells 14 and 26 of a light transmission mold, and calcites 16 and 28, since a faraday's rotation angle is read, a photo detector 24 and the quantity of light sent out to 36 sides can be made to increase, and, theoretically, incidence of about 100% of the quantity of light of the linearly polarized wave light LIN which penetrated the polarizer of the light source 38 will be carried out, without using reflection of light.

[0042] Moreover, 1st ferromagnetism Faraday cell 14 of this example also has the function to impress optical bias to the linearly polarized wave light LIN.
[0043] That is, when a permanent magnet was used for impression of a field and a Faraday cell with the larger Verdet constant than fiber 12a like ferromagnetic Faraday cell 16 was not combined in order to make the optical FAIBA sensor 12 go around completely to a conductor 10 in case optical bias was impressed to the linearly polarized wave light LIN, based on learning that optical bias is not obtained, it constituted from a principle of the circumference integral of ampere in this way.
[0044] Furthermore, since the field of the strength in which a component carries out magnetic saturation to 1st and 2nd ferromagnetism Faraday cells 14 and 26 is impressed with permanent magnets 14b and 26b in the case of this example, even if a field joins permanent magnets 14b and 26b from the exterior, the operating point does not change.
[0045] Moreover, even if temperature dependence is in the Faraday-rotation ability of ferromagnetic Faraday cells 14 and 26, the effect can be made small by performing signal processing which considers the sum of the modulation factor of two signals as the output of a system.
[0046] In addition, although the case where 1st ferromagnetism Faraday cell 14 had been arranged to incidence one end of the optical fiber sensor 12 was illustrated in the above-mentioned example, even if operation of this invention is not limited to this and it installs it in reflective one end of the optical fiber sensor 12, the same operation effectiveness is acquired.
[0047] Moreover, the calcites 16 and 28 shown in the above-mentioned example may be the optics of light reflex molds, such as a polarization beam splitter. The example in this case is shown in drawing 2 .
[0048] In the example shown in drawing 2 , the combination of the calcites 16 and 28 of the example of drawing 1 and prism 18 and 30 is transposed to polarization beam splitters 17 and 29. With this configuration, the quantity of light which carries out incidence to an optoelectric transducer 36 can be made larger than the approach currently indicated by the advanced-technology paper.
[0049] Moreover, if the effect of the perimeter environment of the 1st ferromagnetism Faraday-cell 14 section is disregarded, plane-of-polarization maintenance FAIBA 20 shown in the above-mentioned example can omit this, and shows the example in this case to drawing 3 and 4.
[0050] The example shown in drawing 3 is the case where plane-of-polarization maintenance FAIBA 20 is omitted by drawing 1 , and the example shown in drawing 4 is the case where plane-of-polarization maintenance FAIBA 20 is omitted by drawing 2 , and, in any case, can lessen the mark of a component part.
[0051]
[Effect of the Invention] As the example explained to the detail above, since the amount of incident light of a photo detector can be made to increase, according to the measuring device of the current concerning this invention, the SN ratio of current detection can avoid problems, such as aggravation, and ephemeralization of the light source and upgrading of the electronic circuitry further for light-receiving, by the easy configuration.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] About the measuring device of the current using the Faraday effect, especially, in the measuring device of a current using an optical fiber sensor, this invention carries out incidence of the light from the end side of a sensor, and relates to the amelioration technique of the amperometry equipment of the reflective mold reflected by the other end side.

[Translation done.]

PRIOR ART

[Description of the Prior Art] The measuring device of the current using the Faraday effect which the plane of polarization of light rotates according to an operation of a field is known, and there is an advantage of not being influenced of electromagnetic noise in the measuring device of such a current, for example, it is used for measurement of the current within the switchgear of a gas insulation type.
[0003] There is a thing of a method which makes the periphery of the conductor with which the measured current is flowing go an optical fiber sensor around among the measuring devices of this kind of current, and that example is indicated by JP,7-248338,A and the technical paper IEEE of the 1997 issue (PE-494-PWRD-0-01-1977).
[0004] With the measuring device of the current currently indicated by this official report and technical paper, by reflecting the linearly polarized wave light which carried out incidence from the incidence edge of the optical fiber sensor arranged so that the conductor with which the measured current is flowing may be surrounded by the end face of the opposite side, linearly polarized wave light is made to go within an optical fiber sensor, and it has composition which carries out outgoing radiation from an incidence edge again.
[0005] The following features are acquired in the measuring device of a current using the optical fiber sensor of such a reflective mold.
** . When there is no birefringence in the stability optical fiber sensor of the polarization to deformation of a curve, the polarization condition of the light which carries out re-outgoing radiation from the incidence edge of an optical fiber sensor stops being dependent on curvilinear deformation of an optical fiber sensor.
** . -- stability torsion of the polarization to change of torsion stress double refraction -- add a circle birefringence to an optical FAIBA sensor, and even if temperature dependence is in the magnitude of a circle birefringence, stop in addition, depending on temperature for the polarization condition of the light which carries out re-outgoing radiation from the incidence edge of an optical fiber sensor in the configuration aiming at the stability of polarization
** . By making the expansion light of a faraday's rotation angle go, a faraday's rotation angle can change twice and a modulation factor can be raised.
[0006] Since it has such features, the stable property can be given to various disturbance to an optical fiber sensor, and sensibility can be raised by improvement in a modulation factor.
[0007] The disturbance of a place here is addition of the force made to transform the curve of an optical fiber sensor, and addition of the force which makes an optical fiber sensor ingredient generate stress and distortion.
[0008] However, according to examination of this invention persons, there was a technical technical problem explained below in the measuring device of a current using the reflective mold optical fiber sensor currently indicated by the above-mentioned official report etc.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As the example explained to the detail above, since the amount of incident light of a photo detector can be made to increase, according to the measuring device of the current concerning this invention, the SN ratio of current detection can avoid problems, such as aggravation, and ephemeralization of the light source and upgrading of the electronic circuitry further for light-receiving, by the easy configuration.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] That is, in the measuring device of a current using the reflective mold optical fiber sensor currently indicated by the official report mentioned above, the beam splitter constituted with the semitransparent mirror just before the incidence edge of an optical fiber sensor is installed as a reader of a faraday's rotation angle generated in the optical fiber sensor.
[0010] However, even if a beam splitter separates spectrally and designs light the optimal using transparency and reflection of light as known well, the quantity of light which can carry out incidence to a photo detector turns into 25% or less which passed the polarizer of the quantity of light on a principle.
[0011] If the amount of incident light of a photo detector decreases, problems, like the processing high-class to the electronic circuitry for light-receiving to which a burden is placed on the light source which the SN ratio of current detection gets worse and cannot make a speed of response quick, and a life of a lamp becomes short is needed will be caused.
[0012] Moreover, a manufacture process becomes very complicated in order to form the reflective film and an antireflection film in a beam splitter, while the optimum design (optimization of a reflection factor and permeability, optimization of the reflection and the permeability ratio of P polarization and S polarization, control of a jump of the phase of the reflex time of P polarization and S polarization) of the polarization property of a beam splitter becomes complicated.
[0013] Furthermore, since the beam splitter needed to set the optical axis by other optics correctly, it had the problem of needing precise structure for the anchoring part. By the approach proposed by the technical paper especially mentioned above, in order to repeat unstable transparency and reflection with a beam splitter or a half mirror no less than 4 times, such a problem becomes very remarkable.
[0014] This invention is to offer the measuring device of a current with which a configuration becomes easy while it is made in view of such a conventional trouble and can make the amount of incident light of a photo detector increase.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention carries out circumference installation of the optical fiber sensor at the periphery of the conductor with which the measured current is flowing. In the measuring device of the current which measures the faraday's rotation angle of said linearly polarized wave light which rotates the linearly polarized wave light which carried out incidence from the end side of said optical fiber sensor by the field of said measured current when it is made to reflect by the other end side of said optical fiber sensor A ferromagnetic Faraday cell with the magnetic-saturation nature of the light transmission mold which is installed in either the incidence edge of said optical fiber sensor, or a reflective edge, and only a predetermined include angle makes rotate the plane of polarization of said linearly polarized wave light, It was installed in the incidence edge [of said optical fiber sensor], or front end side of said ferromagnetic Faraday cell, and has the polarization separation component of the light transmission mold which separates spectrally the outgoing radiation light from said optical fiber sensor, and is led to a photo detector. Since according to this configuration a faraday's rotation angle is read without using reflection of light, the quantity of light sent out to a photo detector side can be made to increase. Said ferromagnetic Faraday cell can impress optical bias to said linearly polarized wave light. The field which carries out magnetic saturation to said ferromagnetic Faraday cell can be impressed. Said predetermined include angle of said ferromagnetic Faraday cell can be set as 22.5 degrees. A lead glass optical fiber can be used for said optical fiber sensor. A permanent magnet can be used for impression of the field of said ferromagnetic Faraday cell. Said measured current is an alternating current, photo electric conversion of the two light which carried out polarization separation with said polarization separation component can be carried out, and the sum of the modulating signal of two acquired electrical signals can be considered as an output.
[0016]
[Embodiment of the Invention] Hereafter, the gestalt of desirable operation of this invention is explained to a detail with reference to an accompanying drawing. Drawing 1 shows the 1st example of the measuring device of the current concerning this invention.
[0017] The measuring device of the current shown in this drawing has the optical FAIBA sensor 12 by which circumference installation was carried out on the periphery of the conductor 10 with which the measured current I0 is flowing. It is amperometry equipment of the reflective mold which makes it radical Motohara ** to measure the faraday's rotation angle of the linearly polarized wave light which rotates the linearly polarized wave light which carried out incidence from the end side of this optical fiber sensor 12 by the field of the measured current I0 when it is made to reflect by the other end side of the optical fiber sensor 12.
[0018] The optical fiber sensor 12 consists of optical FAIBA 12a which consisted of lead glass FAIBA, and reflective mirror 12b prepared in the other end side (reflective edge) of this optical FAIBA 12a.
[0019] While 1st ferromagnetism Faraday cell 14 is formed on the optical axis by the side of an end optical fiber 12a side (incidence edge), the 1st calcite (1 shaft birefringence optic) 16 is formed in incidence one end of this 1st ferromagnetism Faraday cell 14.
[0020] 1st ferromagnetism Faraday cell 14 is a thing of a light transmission mold which carries out

predetermined include-angle (22.5 degrees) rotation of the plane of polarization of linearly polarized wave light, and consists of YIG block 14a and permanent magnet 14b installed in the periphery of this block 14a.

[0021] Magnetic saturation of the field of permanent magnet 14b is carried out, it has come and the field which carried out magnetic saturation is impressed to YIG block 14a.

[0022] While the 1st calcite 16 makes the linearly polarized wave light which carried out incidence on the optical axis penetrate as it is, the birefringence of the incident light which shifted from the optical axis is carried out, it carries out outgoing radiation, and prism 18 and end opening of plane-of-polarization maintenance FAIBA 20 are arranged at incidence one end of a calcite 16.

[0023] Contiguity arrangement of the end opening of a multimode optical fiber 22 is carried out at outgoing radiation one end of prism 18, other end opening of this multimode optical fiber 22 is arranged near the optoelectric transducer 24, and the outgoing radiation light from prism 18 carries out incidence to an optoelectric transducer 24.

[0024] Other end opening of the plane-of-polarization maintenance fiber 20 is arranged on the optical axis of 2nd ferromagnetism Faraday cell 26.

[0025] Like 1st ferromagnetism Faraday cell 14, 2nd ferromagnetism Faraday cell 26 is a thing of a light transmission mold which carries out predetermined include-angle (45 degrees) rotation of the plane of polarization of linearly polarized wave light, and consists of YIG block 26a and permanent magnet 26b installed in the periphery of this block 26a.

[0026] The 2nd calcite 28 is installed in incidence one end of 2nd ferromagnetism Faraday cell 26. This 2nd calcite 28 is equipped with the same optical function as the 1st calcite 16.

[0027] Prism 30 and end opening of plane-of-polarization maintenance FAIBA 32 are arranged at incidence one end of the 2nd calcite 28.

[0028] Contiguity arrangement of the end opening of a multimode optical fiber 34 is carried out at outgoing radiation one end of prism 30, other end opening of this multimode optical fiber 34 is arranged near the optoelectric transducer 36, and the outgoing radiation light from prism 30 carries out incidence to an optoelectric transducer 36.

[0029] Other end opening of the plane-of-polarization maintenance fiber 32 is connected to the light source 38. The polarization light of the linearly polarized light carries out incidence of the light by which outgoing radiation is carried out from the light source 38 to a fiber 32 by making the polarizer of an illustration abbreviation etc. penetrate.

[0030] In addition, in response to the fact that the electrical signal sent out from optoelectric transducers 24 and 32, the components shown in drawing 1 with the sign 40 are electronic circuitries which perform data processing which asks for the sum of a modulation factor, for example, are explained by the technical paper (the Institute of Electrical Engineers of Japan paper magazine B, 116 No. 1, pages 93-103) of issue in full detail in 1996.

[0031] In the measuring device of the current constituted as mentioned above, with the plane-of-polarization maintenance fiber 32, the linearly polarized wave light LIN sent out from the light source 38 is in the condition which maintained the polarization condition, carries out incidence on the optical axis of the 2nd calcite 28, and it penetrates this, without causing a birefringence, and the linearly polarized wave light LIN which carried out outgoing radiation from the 2nd calcite 28 carries out incidence to 2nd ferromagnetism Faraday cell 26.

[0032] The linearly polarized wave light LIN which carried out incidence to 2nd ferromagnetism Faraday cell 26 penetrates this, without 45 degrees being rotated and carrying out incidence to plane-of-polarization maintenance FAIBA 20, and plane of polarization's maintaining this polarization condition, and incidence's being carried out on the optical axis of the 1st calcite 16, and causing a birefringence, in case this is penetrated, and the linearly polarized wave light LIN which carried out outgoing radiation from the 1st calcite 16 carries out incidence to 1st ferromagnetism Faraday cell 14.

[0033] In case the linearly polarized wave light LIN which carried out incidence to 1st ferromagnetism Faraday cell 14 penetrates this, 22.5 more degrees of plane of polarization are rotated, it carries out incidence to the optical fiber sensor 12, and incidence of the reflected light LOUT which reflected the

periphery of a conductor 10 by reflective mirror 12b as ** is again carried out to 1st ferromagnetism Faraday cell 14.
[0034] In case the reflected light LOUT passes 1st ferromagnetism Faraday cell 14, 22.5 degrees of plane of polarization are rotated, and it carries out incidence of it to the 1st calcite 16. Consequently, when the reflected light LOUT which carries out incidence to a calcite 16 removes the faraday's rotation angle by the measured current I0, the plane of polarization of the linearly polarized wave light LIN which carried out outgoing radiation from now on will carry out incidence of it, after a total of 45 degrees has rotated.
[0035] For this reason, in case the reflected light LOUT passes the 1st calcite 16, a lifting and reinforcement are made to separate a birefringence spectrally into every 1/2 reflected light LOUT1 and this reflected light LOUT2, and it carries out outgoing radiation.
[0036] The output signal from which incidence of the reflected light LOUT1 was carried out to the optoelectric transducer 24 through prism 18 and a multimode optical fiber 22, and while it was separated spectrally was changed into the electrical signal with the component 24 inputs into an electronic circuitry 40.
[0037] Through the plane-of-polarization maintenance fiber 20, incidence of the reflected light LOUT2 of another side separated spectrally is carried out to 2nd ferromagnetism Faraday cell 26, and where 45-degree plane of polarization is again rotated with a component 26, it carries out incidence to the 2nd calcite 28.
[0038] Consequently, when the reflected light LOUT2 which carries out incidence to the 2nd calcite 28 removes the faraday's rotation angle by the measured current I0, the plane of polarization of the linearly polarized wave light LIN which carried out outgoing radiation from now on will carry out incidence of it, after a total of 90 degrees has rotated.
[0039] For this reason, in case the reflected light LOUT2 passes the 2nd calcite 28, a lifting and its all go a birefringence to a prism 30 side. Incidence of the reflected light LOUT2 which passed prism 30 is carried out to an optoelectric transducer 36 through a multimode optical fiber 34, and the output signal changed into the electrical signal with the component 36 is inputted into an electronic circuitry 40.
[0040] Then, the measured current I0 is searched for by performing signal processing predetermined in the electronic circuitry 40 which received the output signal from optoelectric transducers 24 and 36.
[0041] Now, according to the measuring device of the current constituted as mentioned above, with the combination of ferromagnetic Faraday cells 14 and 26 of a light transmission mold, and calcites 16 and 28, since a faraday's rotation angle is read, a photo detector 24 and the quantity of light sent out to 36 sides can be made to increase, and, theoretically, incidence of about 100% of the quantity of light of the linearly polarized wave light LIN which penetrated the polarizer of the light source 38 will be carried out, without using reflection of light.
[0042] Moreover, 1st ferromagnetism Faraday cell 14 of this example also has the function to impress optical bias to the linearly polarized wave light LIN.
[0043] That is, when a permanent magnet was used for impression of a field and a Faraday cell with the larger Verdet constant than fiber 12a like ferromagnetic Faraday cell 16 was not combined in order to make the optical FAIBA sensor 12 go around completely to a conductor 10 in case optical bias was impressed to the linearly polarized wave light LIN, based on learning that optical bias is not obtained, it constituted from a principle of the circumference integral of ampere in this way.
[0044] Furthermore, since the field of the strength in which a component carries out magnetic saturation to 1st and 2nd ferromagnetism Faraday cells 14 and 26 is impressed with permanent magnets 14b and 26b in the case of this example, even if a field joins permanent magnets 14b and 26b from the exterior, the operating point does not change.
[0045] Moreover, even if temperature dependence is in the Faraday-rotation ability of ferromagnetic Faraday cells 14 and 26, the effect can be made small by performing signal processing which considers the sum of the modulation factor of two signals as the output of a system.
[0046] In addition, although the case where 1st ferromagnetism Faraday cell 14 had been arranged to incidence one end of the optical fiber sensor 12 was illustrated in the above-mentioned example, even if

operation of this invention is not limited to this and it installs it in reflective one end of the optical fiber sensor 12, the same operation effectiveness is acquired.
[0047] Moreover, the calcites 16 and 28 shown in the above-mentioned example may be the optics of light reflex molds, such as a polarization beam splitter. The example in this case is shown in drawing 2 .
[0048] In the example shown in drawing 2 , the combination of the calcites 16 and 28 of the example of drawing 1 and prism 18 and 30 is transposed to polarization beam splitters 17 and 29. With this configuration, the quantity of light which carries out incidence to an optoelectric transducer 36 can be made larger than the approach currently indicated by the advanced-technology paper.
[0049] Moreover, if the effect of the perimeter environment of the 1st ferromagnetism Faraday-cell 14 section is disregarded, plane-of-polarization maintenance FAIBA 20 shown in the above-mentioned example can omit this, and shows the example in this case to drawing 3 and 4.
[0050] The example shown in drawing 3 is the case where plane-of-polarization maintenance FAIBA 20 is omitted by drawing 1 , and the example shown in drawing 4 is the case where plane-of-polarization maintenance FAIBA 20 is omitted by drawing 2 , and, in any case, can lessen the mark of a component part.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the components plot plan showing the 1st example of the measuring device of the current concerning this invention.
[Drawing 2] It is the components plot plan showing the 2nd example of the measuring device of the current concerning this invention.
[Drawing 3] It is the components plot plan showing the 3rd example of the measuring device of the current concerning this invention.
[Drawing 4] It is the components plot plan showing the 4th example of the measuring device of the current concerning this invention.
[Description of Notations]
10 Conductor
12 Optical Fiber Sensor
12a Optical fiber
12b Reflective mirror
14 1st Ferromagnetism Faraday Cell
14a YIG block
14b Permanent magnet
16 Calcite
26 2nd Ferromagnetism Faraday Cell
28 2nd Calcite

[Translation done.]

* NOTICES *

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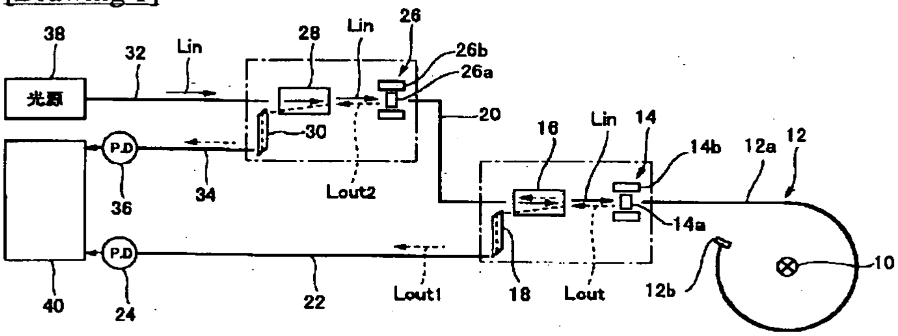
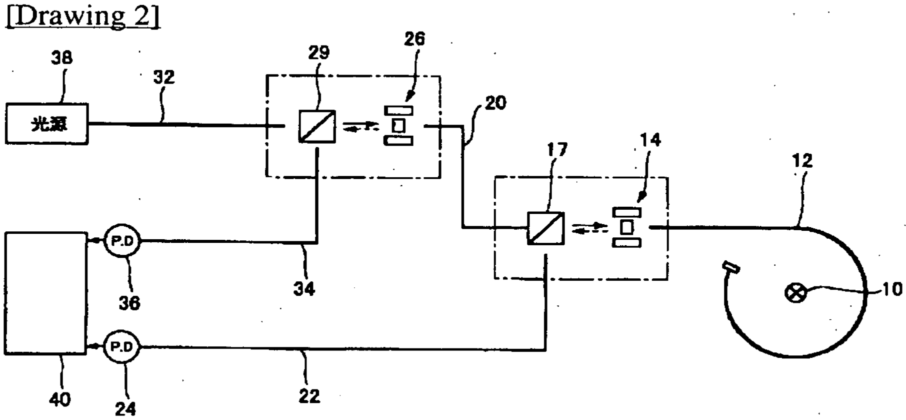
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

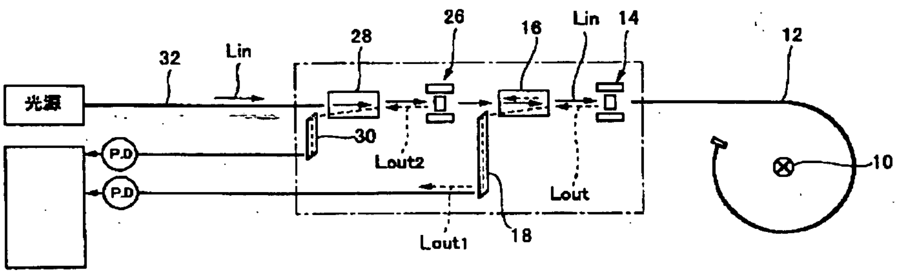
[Drawing 1]



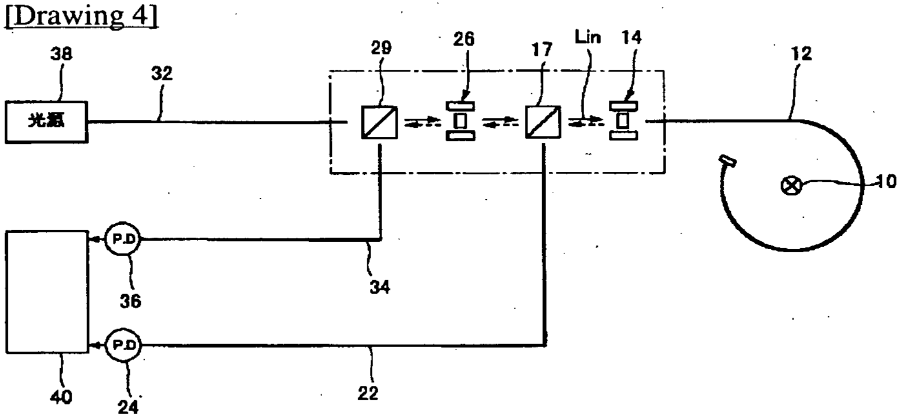
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]